

The diagram illustrates the control system for a vehicle with a manual transmission. It features several interconnected components:

- 1**: A large rectangular block representing the main control system or engine.
- 2**: A rectangular block connected to **3** by a vertical double-headed arrow.
- 3**: A rectangular block connected to **4** by a horizontal double-headed arrow.
- 4**: A rectangular block connected to **5** by a vertical double-headed arrow.
- 5**: A rectangular block connected to **6** by a vertical double-headed arrow.
- 6**: A rectangular block connected to **7** by a horizontal double-headed arrow.
- 7**: A rectangular block connected to **9** by a vertical double-headed arrow.
- 8**: A rectangular block connected to **7** by a horizontal double-headed arrow.
- 9**: A rectangular block connected to **10** by a horizontal double-headed arrow.
- 10**: A rectangular block connected to **11** by a horizontal double-headed arrow.
- 11**: A rectangular block connected to **12** by a horizontal double-headed arrow.
- 12**: A rectangular block connected to **13** by a horizontal double-headed arrow.

The diagram shows a complex network of control lines and feedback loops between these components, indicating a sophisticated control system for a vehicle with a manual transmission.

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A METHOD AND A RADIO TERMINAL FOR INTERACTION WITH A SERVICE PROVIDER

The invention relates to a mobile radio terminal for a digital cellular radio communication system, which makes efficient use of a radio resource, a method for the efficient use of bandwidth for mobile radio services, particularly, multimedia radio services, and a digital cellular radio communication system including a number of said mobile radio terminals.

Known digital cellular radio communication system, such as, for example, GSM (Global System for Mobile Communication), or Digital Cellular System 1800 MHz (DCS 1800), include a number of base stations, each serving a number of mobile radio terminals and being connected to a public telephone network, i.e. a fixed network, the functionality of each mobile radio terminal being determined by a software programme located therein. The manner in which systems, such as GSM and DCS 1800, are generally operated and controlled, is well known to persons skilled in the art and will not, therefore, be dealt with, in any great detail, in this patent specification. The nature and scope of the present invention will be readily understood, by persons skilled in the art, from the following description of various aspects of the invention.

In practice, a multimedia service normally consists of a number of functions, for example, audio, data and video, and each of these functions can produce a varying flow of data and make different demands on a carrier service. If the carrier service uses a radio based access to a transport network, then a situation will arise where a multimedia service, with a strongly varying need for transmission capacity, will have to use a carrier service which cannot guarantee a required capacity and/or quality. In addition, the capacity and/or quality of the carrier service can also be subject to variation. Furthermore, the radio medium is a limited resource and it is, therefore, very important that this resource should be used in an efficient manner.

Thus, if a multimedia service cannot be editions on a radio medium, a mobile multimedia service will:

- be of poor quality because variations in the capacity and/or quality of the carrier network will result in strongly

varying service quality; and

- 5 - consume an unreasonable large part of the radio resource, i.e. the number of users having simultaneous access will be extremely limited, and, as a consequence of this, the service will become very expensive, thereby making it less attractive (i.e. uninteresting) to the great majority of users.

10 It is an object of the present invention to provide a mobile radio terminal which makes efficient use of a radio resource, thereby making a mobile service and, in particular, a mobile multimedia service, more attractive to users.

15 It is another object of the present invention to provide a method for the efficient use of bandwidth for mobile radio services, particularly, multimedia radio services.

20 It is another object of the present invention to provide a mobile radio communication system including a mobile radio terminal which makes efficient use of a radio resource.

25 The present invention provides a mobile radio terminal for a digital cellular radio communication system including a number of base stations connected to a public network, each of said base stations being adapted to serve a number of mobile radio terminals, characterised in that said mobile radio terminal includes:

- 30 - negotiation means for initial negotiation with a service provider for the provision of a service application required by a terminal user;
- control means for dynamically controlling:
- 35 - individual elements of the service application;
- interactions between said individual elements; and
- interactions between the service application and a carrier

network; and

- code division access means for enabling different users to share a radio resource.

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The code division access means may use CDMA, or COFDM.

10 The mobile radio terminal may include a radio data modem for transmitting and receiving data for said service application, said data modem including an access function for controlling access to said carrier network; and a mobile user terminal interactively connected to said data modem, said mobile user terminal including terminal user means adapted to enable a user to specify and control a required service application; in that said negotiation means are adapted to negotiate a
15 service goal with said service provider which satisfies said user requirements; in that a service function of said mobile user terminal is adapted, on completion of said negotiation, to request said access function to establish a radio data channel connection to said service provider, which makes it possible to achieve said service goal; and in
20 that said radio data modem is adapted, during provision of the required service, to dynamically co-ordinate and control the service application by ensuring that said radio data channel continues to makes it possible to achieve said service goal.

25 The mobile radio terminal may include a radio data modem for transmitting and receiving information data, said data modem being adapted to utilise a radio resource to accommodate different service applications and includes an access function for controlling access, by
30 said mobile radio terminal, to a carrier network, and a data flow control function for said data modem; and a mobile user terminal including a control function for specifying and controlling a service application required by a terminal user a service function for establishing the service application and negotiating a service goal, with a provider of the required service application, which satisfies
35 said user requirements, in that said service function is adapted, on completion of said negotiation, to request said access function to establish a radio data channel connection to said service provider, which makes it possible to achieve said service goal; and in that said radio data modem is adapted, during provision of the required service,

to dynamically co-ordinate and control the service application by ensuring that said radio data channel continues to make it possible to achieve said service goal.

5 The service goal may specify the type and quality of the service available from a service provider, and the achievement of the service goal may be determined by the QoS provided by the established radio data channel. The QoS may be determined by demands imposed by the service application.

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The service provider may include the service functions in a fixed network and/or the service functions belonging to another user of the digital cellular radio communication system.

15 In accordance with the invention, said data modem, in the event that the required QoS for achievement of the service goal cannot be met, is informed of the maximum QoS that can be offered, the mobile user terminal is informed by said data modem of the offered QoS, and, on receipt of the information concerning a restricted QoS, is adapted to
20 optimise the service application, on the basis of the offered QoS.

Also, in the event that said data modem receives information concerning an improved QoS, said mobile user terminal is informed of the improvement and, on receipt of the information concerning an improved
25 QoS, optimises the service application, on the basis of the improvement.

The negotiation means may be adapted to renegotiate the service goal during provision of the service application and the renegotiation of the service goal may result in an extension of the service
30 application.

In a preferred arrangement for the mobile radio terminal, the service application is a multimedia application and the individual elements of the multimedia application may be video, audio and data.
35

The individual elements of the service application may be allotted resource frames containing the maximum allowable bandwidth that may be used for a respective element of the service application, and how much bandwidth may be used, on average, by said element may be allotted resource

frames containing, for each individual element of the service application, the maximum allowable bandwidth that may be used for a respective element of the service application, and how much bandwidth may be used, on average, by said respective element of the service application.

The resource frames may contain the quality requirements of respective elements of the service application and may be associated with a multimedia application.

The present invention also provides a method for the efficient use of bandwidth for mobile radio services provided by a digital cellular radio communication system including a number of mobile user terminals, each having a radio data modem for transmitting and receiving information data on a radio channel, and a number of base stations connected to a public network, each of said base stations being adapted to serve a number of mobile terminals, said method being characterised by the steps of:

- a user of a mobile terminal specifying a required service application;
- said mobile terminal initiating the establishment of a service application, on the basis of said user requirements, and negotiating a service goal, which satisfies said user requirements, with a provider of the required service application;
- said mobile terminal, on completion of said service goal negotiation, establishing a radio data channel between a respective radio data modem and said service provider, which makes it possible to achieve said service goal, said radio modem being adapted to utilise the radio resource to accommodate different service applications; and
- said data modem, during provision of the required service, dynamically co-ordinates and controls the service application by ensuring that said radio data channel continues to make it possible to achieve said service goal.

5 In accordance with the method, the service goal may specify the type and quality of the service available from a service provider, and the service provider may include the service functions in a fixed network and/or the service functions belonging to another user of the digital cellular radio communication system.

10 In accordance with the method, the service goal may be determined by the QoS provided by the established radio data channel, and the QoS may be determined by demands imposed by the service application.

The method may include the steps of:

- 15 - in the event that the required QoS for achievement of the service goal cannot be met, said data modem is informed of the maximum QoS that has been offered;
- said mobile terminal is informed by said data modem of the offered QoS; and
- 20 - said mobile terminal, on receipt of the information concerning a restricted QoS, is adapted to optimise the service application, on the basis of the offered QoS.

25 Optimisation of the service application, on the basis of the offered QoS, may, according to the invention, include the step of prioritising individual elements of the service application, said prioritisation resulting in a deterioration of the quality of at least one of said elements, and/or temporary deactivation of at least one other of said elements.

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The method may include the steps of:

- 35 - in the event that the data modem receives information concerning an improved QoS, said mobile terminal is informed of the improvement; and
- said mobile terminal, on receipt of the information concerning an improved QoS, optimises the service application, on the basis of the improvement.

Optimisation of the service application, on the basis of the improved QoS, may, according to the invention, include the step of prioritising individual elements of the service application, said prioritisation resulting in the quality of at least one of said elements being improved, and/or activation of at least one other of said elements.

The method may include the step of renegotiating the service goal, during provision of the service application, and such renegotiation of the service goal may result in an extension of the service application.

In a preferred method, the service application is a multimedia application and the individual elements of the multimedia application include video, audio and data.

The method may include the steps of allotting resource frames to the individual elements of the service application, each resource frame containing the maximum allowable bandwidth that may be used for a respective element of the service application, and how much bandwidth may be used, on average, by said respective element of the service application.

The method may include the steps of allotting resource frames to the radio data modem, said resource frames containing, for each element of the service application, the maximum allowable bandwidth that may be used for the said element, and how much bandwidth may be used, on average, by the said element.

The resource frames may contain the quality requirements of respective elements of the service application and may be associated with a multimedia application.

The method may use code division access, for example, CDMA, or COFDM, to enable different users to share a radio resource.

The invention further provides a digital cellular radio communication system including a number of mobile radio terminals and a number of base stations connected to a public network, each of said base

stations being adapted to serve a number of mobile radio terminals, characterised in that each of said mobile radio terminals are provided by a mobile radio terminal as outlined in preceding paragraphs.

5 The invention further provides a mobile radio terminal for a digital cellular radio communication system including a number of base stations connected to a public network, each of said base stations being adapted to serve a number of mobile radio terminals, characterised in that said mobile radio terminal is adapted to effect efficient use of a
10 radio resource and includes a service function for optimising a service application required by a terminal user on the basis of a service goal and existing bandwidth of a radio data channel; a radio data modem including an access function for dynamically controlling said radio data channel to provide a connection which makes it possible to achieve the
15 service goal, and a data flow function for power control, channel encoding and code division of said radio data channel, said access function interacting with said service function; and resource management means for managing said interaction between said service and access functions.

20 The resource management means may include first management means for control of resources used by elements of said service application, said resources being associated with control of the data flow function of said radio data modem, and said service application, and in that said
25 control is effected by allocation application.

30 The resource management means may include second management means for control of said radio resource, said radio resource being associated with control of the data flow function of said radio data modem to enable momentary use, by said radio data modem, of the bandwidth needed on said radio data channel, and in that said control is effected by allocation of resource frames to said radio data modem.

35 The foregoing and other features of the present invention will be better understood from the single figure of the accompanying drawings which diagrammatically illustrates, in the form of a block diagram, a mobile multimedia radio terminal

It will be seen from subsequent description of the present invention that, in order to achieve efficient use of a radio resource,

it will be necessary to provide, inter alia:

- an initial negotiation of service provision;
- 5 - dynamic control of individual multimedia applications;
- dynamic interaction between multimedia applications;
- dynamic interaction between service and carrier network; and
- 10 - the correct type of access technology.

In the single figure of the accompanying drawings, the physical connections are shown as full lines, a radio boundary is shown by the
15 dotted line 10, and the other dotted lines are logical connections.

As can be seen from the single figure of the accompanying drawings, a mobile multimedia radio terminal, according to the present invention, includes a mobile user terminal 1 and a radio modem 8.

20 The mobile user terminal 1 includes a control function 2, multimedia applications 4 to 6 and a service function 3. The radio modem 8 which is used to effect the transmission and receipt of information data on a radio channel, includes an access function 7 which
25 is connected to, and interacts with, a function 9 for effecting power control, channel encoding and code division of a physical data channel 12.

It will be seen from subsequent description that, in essence, the
30 present invention resides in the structure, the interaction between and the features of the functional units 2 to 7 and 9. Thus, the multimedia service provided by the mobile multimedia radio terminal, according to the present invention, can be divided into a number of component parts which are based on different functional concepts.

35 The control function 2, which is connected to, and interacts with, the service function 3, enables a user of the mobile terminal 1 to control a mobile multimedia service and obtain information concerning the behaviour of the service. In other words, the multimedia mobile

terminal includes means for negotiating with a multimedia service provider for the provision of a multimedia service application required by a user of the terminal.

5 The service function 3 which, as shown in the single figure of the accompanying drawings, is connected to, and interacts with, each of the multimedia applications 4 to 6, is adapted to provide a user of the mobile terminal 1 with as good a service as is possible, within
10 existntrol the individual multimedia applications 4 to 6, and the interaction between the applications. The service function 3 is also linked to the access function 7 of the radio modem 8 via a control channel 11.

15 Thus, based on the requirements of a user, a multimedia service, with service functions belonging to an operator, or other users, is firstly negotiated by means of the service function 3 and the access function 7. On completion of the negotiation procedure, the multimedia applications 4 to 6 are dynamically co-ordinated and controlled, i.e.
20 the quality of the multimedia applications are optimised, on the basis of possible limitations in respect of the connection reported by the access function 7.

25 The multimedia applications 4 to 6 which, respectively, relate to video, audio, and data applications, can, in accordance with the present invention, be controlled separately from the service function. The applications 4 to 6 are each connected to, and interact with, the function 9 of the radio modem 8 by means of the data channel 12. Any one, or more, of the multimedia applications can, in accordance with the present invention, be activated and deactivated either before, or
30 during, service provision. Also, the quality level of the multimedia service can be set either before, or during, service provision. This means that utilization of bandwidth, i.e. the generated bits/s, of the multimedia service can be controlled during the provision of the service.

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 The access function 7 controls the access of the mobile radio terminal 1 to an operator's carrier network. This includes, for instance, the logic for managing the signalling towards a fixed network which is needed to establish a connection, and the control and

supervision of the mobile terminal's bandwidth utilization and handover algorithms. The handover algorithms determine the base station to which the mobile radio terminal 1 should be connected, via the radio mobile 8, for the provision of the service function. The access
5 function 7 has the task to continuously attempt to provide the service function 3 with a connection which makes it possible to achieve a desired service goal, i.e. interaction between the multimedia applications 4 to 6 and the carrier network is dynamically controlled.

10 A method, according to the present invention, for the establishment of a multimedia service, includes the following steps:

- a user of the mobile radio terminal 1 firstly specifies a service requirement by means of the control function 2;
- 15 - the service function 3 initiates the establishment of the service, on the basis of the user's requirements, and negotiates a service goal, i.e. the required quality and type(s) of multimedia application, for example, video,
20 audio, data, or any combinations thereof - the other party to the negotiation comprises service functions in a fixed network belonging to an operator and/or a service function belonging to another user - the negotiated service goal will either satisfy the user's requirements, or be a restricted
25 service goal because the other user, for example, has introduced restrictions which may be in the form of an impaired application quality;
- on completion of the service goal negotiation, the service
30 function 3 requests the access function 7 to establish a connection which will make it possible to achieve the negotiated service goal - this request is expressed in terms of QoS (Quality of Service), where there can be specific demands for different types of applications, for example,
35 can different types of channel encoding be connected to different types of application data - in other words, the radio modem is adapted to utilise the radio resource to accommodate different types of application.

The steps which are effected, in accordance with the method of the present invention, during the provision of a multimedia service, are as follows:

- 5 - the access function 7 is adapted to continuously attempt to provide the service function 3 with a connection which makes it possible to achieve the service goal;
- 10 - if it is not possible to provide such a connection for the service function 3, i.e. the required QoS cannot be obtained, the access function 7 is informed of the maximum QoS that has been offered;
- 15 - if the service function 3 receives information concerning a restricted QoS, it is adapted, on the basis of this restriction, to optimise the multimedia service - in other words, the different applications 4 to 6 are prioritised by the service function 3 and this can result in deterioration of the quality of an application, and/or that certain applications are temporarily deactivated;
- 20 - if the service function 3 receives information concerning an improved QoS, it also adapted, on the basis of this information, to optimise the multimedia service - in other words, the service function 3 will prioritise the different applications 4 to 6 and this can result in the quality of an application being improved, and/or that certain applications are activated; and
- 25 - during the provision of a multimedia service, it is possible for the service goal to be renegotiated, for example, if a user wishes to add a multimedia application.
- 30 - during the provision of a multimedia service, it is possible for the service goal to be renegotiated, for example, if a user wishes to add a multimedia application.

35 In order to effectively control utilization of the applications resource, the applications 4 to 6 are allotted resource frames. The resource frames contain the maximum allowable bandwidth (expressed in bits/s) which may be used, and how much bandwidth (expressed in bits/s) may be allowed to be used, on average. A resource frame is valid until the next resource frame has been received by an application 4 to 6.

This is, therefore, a relatively slow form of resource management.

As is the case with the applications resource, utilization of the radio resource, by the mobile multimedia terminal 1, is controlled by the radio modem 8 being allotted resource frames. The resource frames contain, per application, the maximum allowable bandwidth (expressed in bits/s) which may be used, and how much bandwidth (expressed in bits/s) may be allowed to be used, on average. Furthermore, the resource frames will contain information concerning the quality requirements of respective applications. Quality requirements can be expressed in terms of output power and protection coding, i.e. error correction coding, in the functional unit 9, which influences the utilization of bandwidth on the radio route. A resource frame is valid until the next resource frame has been received by the radio modem 8. This is, therefore, a relatively slow form of resource management.

Control of the applications resource 4 to 6 and the radio modem 8, in a manner as outlined above, will not result in an efficient dynamic utilization of the radio medium, i.e. a rapid adaption of the radio modem 8 to variations in incoming data flow, generated by the multimedia applications 4 to 6. Thus, in order to be able to utilise the radio resource in an efficient manner, the radio modem 8 must be adapted to respond to variations in incoming data flow. Furto construct a system in which the multimedia applications 4 to 6 are adapted to signal to the radio data modem 8 that:

- the generated data flow has changed; and
- the change in the generated data flow should be taken care of by the function 9, before the data flow has reached the radio modem 8.

Since it is not practicable for the data modem 8 to rapidly adapt to variations in incoming data flow, for the reasons outlined above, this problem can be overcome, according to the present invention, by utilizing an access method which supports statistical multiplexing on the radio route. Such an arrangement can be constructed which does not use more bandwidth, on the radio route, than that which is momentarily needed. In order to realise this arrangement, it is necessary to

provide an access method that enables different users to share the same physical resource which, for instance, can be expressed in terms of frequency and time slots. In accordance with the present invention, an access method is used which is based on code division, where different users are separated by means of unique codes, but can use the same frequencies and time slots. Examples of such access methods are COFDM (Coded Orthogonal Frequency Division Multiplex) and CDMA (Code Division Multiple Access).

COFDM is a variant of OFDM (Orthogonal Frequency Division Multiplex) and uses fast Fourier transform (FFT) processing and convolution error coding at the modulator stage. When this is combined with complementary FFT processing and Viterbi decoding at the demodulator, the overall bit error rate is very low. Since the COFDM spectrum has noise-like properties and the signal can be transmitted at relatively low power, it produces very little adjacent channel interference.

CDMA is a method well suited to digital transmission in which all users operate at the same frequency and simultaneously use the whole channel bandwidth. This in turn leads to an improvement in the spectrum utilisation. A unique digital code is added to each digital transmission sequence and the intended receiver station is equipped with the same key. By using correlation detection, the receiver extracts the wanted signal from the noise of all the other transmitters.

It will be seen from the foregoing description that the present invention can, in essence, be divided into three parts, namely:

- a structure which constitutes the basis for how a mobile multimedia application can be designed to effect efficient use of a radio resource;
- the core of the resource management logic, consisting of the interaction between the service function 3 which has the task to optimise the service on the basis of a service goal and existing bandwidth, and the access function 7 which has the task to continuously try to offer a connection that has sufficient bandwidth to achieve the service goal; and

- the management of resources which are divided into two parts, namely:
 - 5 - a comparatively slow management of those resources which control the radio modem 8, via function 9, and the multimedia applications 4 to 6 by the allocation of resource frames; and
 - 10 - a rapid management of resources which makes it possible for the radio modem 8 to use, momentarily, the bandwidth which is needed on the radio route, i.e. managed by the function 9.

15 It will be directly evident from the foregoing description that the present invention has been described in terms of a general structure and associated general procedure and that it can, therefore, be used in a large number of applications. In particular, the invention can be used to advantage for multimedia applications which utilise radio
20 communication, i.e. the multimedia applications generate a varying flow of information and utilise a variable and restricted channel for data transmission.

CLAIMS

1. A mobile radio terminal for a digital cellular radio communication system including a number of base stations connected to a public network, each of said base stations being adapted to serve a number of mobile radio terminals, characterised in that said mobile radio terminal includes:

- negotiation means for initial negotiation with a service provider for the provision of a service application required by a terminal user;

- control means for dynamically controlling:

- individual elements of the service application;

- interactions between said individual elements; and

- interactions between the service application and a carrier network; and

- code division access means for enabling different users to share a radio resource.

2. A radio terminal as claimed in claim 1, characterised in that said radio terminal includes a radio data modem for transmitting and receiving data for said service application, said data modem including an access function for controlling access to said carrier network; and a mobile user terminal interactively connected to said data modem, said mobile user terminal including terminal user means adapted to enable a user to specify and control a required service application; in that said negotiation means are adapted to negotiate a service goal with said service provider which satisfies said user requirements; in that a service function of said mobile user terminal is adapted, on completion of said negotiation, to request said access function to establish a radio data channel connection to said service provider, which makes it possible to achieve said service goal; and in that said radio data modem is adapted, during provision of the required service, to dynamically co-ordinate and control the service application by ensuring that said radio

data channel continues to makes it possible to achieve said service goal.

3. A radio terminal as claimed in claim 1, characterised in that said mobile radio terminal includes:

(a) a radio data modem for transmitting and receiving information data, said data modem being adapted to utilise a radio resource to accommodate different service applications and includes:

- an access function for controlling access, by said mobile radio terminal, to a carrier network; and

- a data flow control function for said data modem; and

(b) a mobile user terminal including:

- a control function for specifying and controlling a service application required by a terminal user;

- a service function for establishing the service application and negotiating a service goal, with a provider of the required service application, which satisfies said user requirements;

in that said service function is adapted, on completion of said negotiation, to request said access function to establish a radio data channel connection to said service provider, which makes it possible to achieve said service goal; and in that said radio data modem is adapted, during provision of the required service, to dynamically co-ordinate and control the service application by ensuring that said radio data channel continues to makes it possible to achieve said service goal.

4. A radio terminal as claimed in claim 2, or claim 3, characterised in that the service goal specifies the type and quality of the service available from a service provider.

5. A radio terminal as claimed in any one of the preceding claims, characterised in that the service provider includes the service functions in a fixed network.

5 6. A radio terminal as claimed in any one of the preceding claims, characterised in that the service provider includes the service functions belonging to another user of the digital cellular radio communication system.

10 7. A radio terminal as claimed in any one of claims 2 to 6, characterised in that the achievement of the service goal is determined by the QoS provided by the established radio data channel.

8. A radio terminal as claimed in claim 7, characterised in that said QoS is determined by demands imposed by the service application.

15 9. A radio terminal as claimed in claim 7, or claim 8, characterised in that, in the event that the required QoS for achievement of the service goal cannot be met, said data modem is informed of the maximum QoS that can be offered, in that said mobile user terminal is informed by said data modem of the offered QoS, and in that said mobile user terminal, on receipt of the information concerning a restricted QoS, is adapted to optimise the service application, on the basis of the offered QoS.

20 10. A radio terminal as claimed in any of claims 7 to 9, characterised in that, in the event that the data modem receives information concerning an improved QoS, said mobile user terminal is informed of the improvement and, on receipt of the information concerning an improved QoS, optimises the service application, on the basis of the improvement.

25 11. A radio terminal as claimed in any one of the claims 2 to 10, characterised in that the negotiation means are adapted to renegotiate the service goal during provision of the service application.

30 12. A radio terminal as claimed in claim 11, characterised in that said renegotiation of the service goal results in an extension of the service application.

35 13. A radio terminal as claimed in any one of the preceding claims, characterised in that the service application is a multimedia application.

14. A radio terminal as claimed in claim 13, characterised in that individual elements of the multimedia application are as follows:

- 5 - video;
- audio; and
- data.

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15. A radio terminal as claimed in any one of the preceding claims, characterised in that said individual elements of the service application are allotted resource frames containing the maximum allowable bandwidth that may be used for a respective element of the service application, and how much bandwidth may be used, on average, by said respective element of the service application.

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16. A radio terminal as claimed in any one of the preceding claims, characterised in that said radio data modem is allotted resource frames containing, for each individual element of the service application, the maximum allowable bandwidth that may be used for a respective element of the service application, and how much bandwidth may be used, on average, by said respective element of the service application.

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17. A radio terminal as claimed in claim 15, or claim 16, characterised in that said resource frames contain the quality requirements of respective elements of the service application.

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18. A radio terminal as claimed in any one of claims 15 to 17, when appended to claim 14, characterised in that each of said resource frames is associated with a multimedia application.

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19. A radio terminal as claimed in any one of the preceding claims, characterised in that said code division access means uses CDMA, or COFDM.

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20. A method for the efficient use of bandwidth for mobile radio services provided by a digital cellular radio communication system including a number of mobile user terminals, each having a radio data

modem for transmitting and receiving information data on a radio channel, and a number of base stations connected to a public network, each of said base stations being adapted to serve a number of mobile terminals; said method being characterised by the steps of:

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- a user of a mobile terminal specifying a required service application;

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- said mobile terminal initiating the establishment of a service application, on the basis of said user requirements, and negotiating a service goal, which satisfies said user requirements, with a provider of the required service application;

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- said mobile terminal, on completion of said service goal negotiation, establishing a radio data channel between a respective radio data modem and said service provider, which makes it possible to achieve said service goal, said radio modem being adapted to utilise the radio resource to accommodate different service applications; and

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- said data modem, during provision of the required service, dynamically co-ordinates and controls the service application by ensuring that said radio data channel continues to makes it possible to achieve said service goal.

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21. A method as claimed in claim 20, characterised in that the service goal specifies the type and quality of the service available from a service provider.

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22. A method as claimed in claim 20, or claim 21, characterised in that the service provider includes the service functions in a fixed network.

35

23. A method as claimed in claim 20, or claim 21, characterised in that the service provider includes the service functions belonging to another user of the digital cellular radio communication system.

24. A method as claimed in any one of the claims 20 to 23, characterised in that the achievement of the service goal is determined

by the QoS provided by the established radio data channel.

25. A method as claimed in claim 24, characterised in that said QoS is determined by demands imposed by the service application.

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26. A method as claimed in claim 24, or claim 25, characterised by the steps of:

10 - in the event that the required QoS for achievement of the service goal cannot be met, said data modem is informed of the maximum QoS that has been offered;

- said mobile terminal is informed by said data modem of the offered QoS; and

15

- said mobile terminal, on receipt of the information concerning a restricted QoS, is adapted to optimise the service application, on the basis of the offered QoS.

20 27. A method as claimed in claim 29, characterised in that optimisation of the service application, on the basis of the offered QoS, includes the step of prioritising individual elements of the service application, said prioritisation resulting in a deterioration of the quality of at least one of said elements, and/or temporary
25 deactivation of at least one other of said elements.

28. A method as claimed in any of claims 25 to 27, characterised by the steps of:

30 - in the event that the data modem receives information concerning an improved QoS, said mobile terminal is informed of the improvement; and

35 - said mobile terminal, on receipt of the information concerning an improved QoS, optimises the service application, on the basis of the improvement.

29. A method as claimed in claim 28, characterised in that optimisation of the service application, on the basis of the improved

QoS, includes the step of prioritising individual elements of the service application, said prioritisation resulting in the quality of at least one of said elements being improved, and/or activation of at least one other of said elements.

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30. A method as claimed in any one of the claims 20 to 29, characterised by the step of renegotiating the service goal, during provision of the service application.

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31. A method as claimed in claim 30, characterised in that renegotiation of the service goal results in an extension of the service application.

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32. A method as claimed in any one of the claims 20 to 31, characterised in that the service application is a multimedia application.

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33. A method as claimed in claim 32, characterised in that the individual elements of the multimedia application are as follows:

- video;
- audio; and
- 25 - data.

30

34. A method as claimed in any one of the claims 20 to 33, characterised by the steps of allotting resource frames to the individual elements of the service application, each resource frame containing the maximum allowable bandwidth that may be used for a respective element of the service application, and how much bandwidth may be used, on average, by said respective element of the service application.

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35. A method as claimed in any one of the claims 20 to 34, characterised by the steps of allotting resource frames to the radio data modem, said resource frames containing, for each element of the service application, the maximum allowable bandwidth that may be used for the said element, and how much bandwidth may be used, on average, by

the said element.

36. A method as claimed in claim 34, or claim 35, characterised in that said resource frames contain the quality requirements of respective elements of the service application.

37. A method as claimed in any one of claims 34 to 36, when appended to claim 33, characterised in that each of said resource frames is associated with a multimedia application.

38. A method as claimed in any one of the claims 20 to 37, characterised in that said method uses code division access to enable different users to share a radio resource.

39. A method as claimed in claims 38, characterised in that said method uses CDMA, or COFDM.

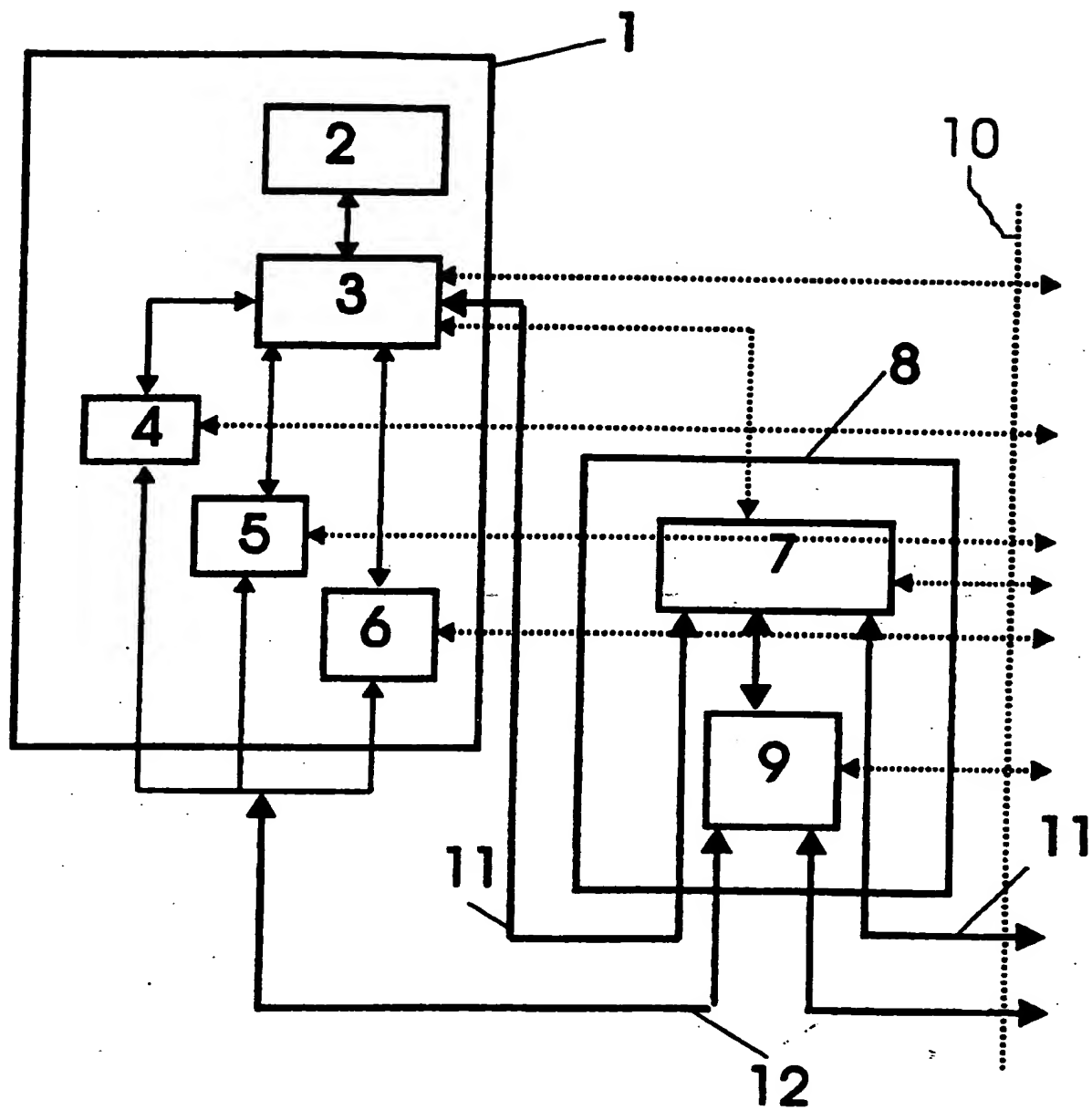
40. A digital cellular radio communication system including a number of mobile radio terminals and a number of base stations connected to a public network, each of said base stations being adapted to serve a number of mobile radio terminals, characterised in that each of said mobile radio terminals are provided by a radio terminal as claimed in any one of claims 1 to 19.

41. A mobile radio terminal for a digital cellular radio communication system including a number of base stations connected to a public network, each of said base stations being adapted to a terminal is adapted to effect efficient use of a radio resource and includes a service function for optimising a service application required by a terminal user on the basis of a service goal and existing bandwidth of a radio data channel; a radio data modem including an access function for dynamically controlling said radio data channel to provide a connection which makes it possible to achieve the service goal, and a data flow function for power control, channel encoding and code division of said radio data channel, said access function interacting with said service function; and resource management means for managing said interaction between said service and access functions.

42. A mobile radio terminal as claimed in claim 41, characterised in

that said resource management means include first management means for control of resources used by elements of said service application, said resources being associated with control of the data flow function of said radio data modem, and said service application, and in that said control is effected by allocation of resource frames to said elements of said service application.

43. A mobile radio terminal as claimed in claim 42, characterised in that said resource management means include second management means for control of said radio resource, said radio resource being associated with control of the data flow function of said radio data modem to enable momentary use, by said radio data modem, of the bandwidth needed on said radio data channel, and in that said control is effected by allocation of resource frames to said radio data modem.



INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 97/00871

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04Q 7/20, H04L 12/00, H04J 13/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5442625 A (GITLIN ET AL), 15 August 1995 (15.08.95), column 1, line 7 - line 20; column 1, line 45 - line 53; column 2, line 10 - line 15, figure 2, abstract, column 5, line 16 - line 25	1-4, 20-23, 40, 41, 43
Y	--	42
Y	US 5408465 A (GUSELLA ET AL), 18 April 1995 (18.04.95), column 14, line 50 - column 15, line 57, abstract	42
A	--	1-4, 20-23, 40, 41, 43

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"B" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"Z" document member of the same patent family

Date of the actual completion of the international search

5 December 1997

Date of mailing of the international search report

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PCT/SE 97/00871

Category*

Relevant to claim No.

22

**1-4, 20-23,
40-43**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE97/00871

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 27-29
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Dependent claim 29 refers to dependent claim 27 that refers to claim 29 in circle.
3. ☒ Claims Nos.: 5-19, 24-39
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

01/10/97.

International application No.
PCT/SE 97/00871

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5442625 A	15/08/95	CA 2145708 A EP 0682423 A JP 8065273 A	14/11/95 15/11/95 08/03/96
US 5408465 A	18/04/95	JP 7170271 A	04/07/95
US 5461611 A	24/10/95	NONE	
US 5497504 A	05/03/96	AU 2588695 A WO 9531868 A	05/12/95 23/11/95

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